DOCUMENT RESUME

ED 158 978 — SE 024 668

TITLE Seed Treatment. Manual 92.
INSTITUTION Missouri Univ., Columbia. Agricultural Experiment Station.; Missouri Univ., Columbia. Extension Div.
PUB DATE 77
NOTE 33p.; For related documents, see SE 024 665-671 and SE 024 748-751; Colored pictures of insects may not reproduce well

EDRS PRICE MF-$0.83 HC-$2.06 Plus Postage.
DESCRIPTORS *Agricultural Production; *Certification; Disease Control; Environment; Grains (Food); *Instructional Materials; *Pesticides; *Post Secondary Education; Safety; *Units of Study
IDENTIFIERS *Missouri; Seeds

ABSTRACT

This training manual provides information needed to meet minimum EPA standards for certification as a commercial applicator of pesticides in the seed treatment category. The text discusses pests commonly associated with seeds; seed treatment pesticides; labels; chemicals and seed treatment equipment; requirements of federal and state seed laws; and safety precautions. (CS)

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SEED TREATMENT

manual 92

This manual was developed in cooperation with The Missouri Department of Agriculture and the Coop Extension Service, University of Missouri.

Assembled by Members of Extension Pesticide Training Team.

SE 024 668

This training manual is intended to provide the information needed to meet the minimum Environmental Protection Agency standards for certification as Commercial Applicators in Category 4--"Seed Treatment". It is also intended to prepare applicators for the examination given by the Missouri Department of Agriculture based on this manual.

This manual does not provide all of the information needed for safe and effective application of seed treatment pesticides. Additional information is available from the manufacturers of products registered for use as seed treatment chemicals and from publications available from the University of Missouri Extension Division.

(This manual was adapted to Missouri conditions from University of Georgia materials.)

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CERTIFICATION OF PESTICIDE APPLICATORS

SEED TREATMENT

Introduction.

In modern agriculture, methods for increasing efficiency and improving the economics of crop production must be constantly developed. Maintaining the quality and performance of seed is vitally important. Even though seed may have been cleaned and stored properly, most seeds carry seed-borne disease organisms that can cause serious losses after planting.

Seed treatment chemicals-- fungicides and insecticides-- have been proved to be worthwhile investments. A good seed treatment, properly applied, will usually increase yields for little relative expense .

Seed treatment can promote at least seven distinct benefits for the farmer before and after seeding:

1. Control seed decay causing organisms carried on or in the seed.
2. Protect the seed and seedlings from decay-causing organisms in the soil-- especially when the soil is too dry, wet, or cold for rapid germination and growth.
3. Protect mechanically damaged seed.
4. Obtain rapid, even emergence and improved stands.
5. Increase yields by controlling and reducing several seed-borne diseases.
6. Protect the seed from insects while in storage.
7. Protect the seed and seedlings from certain soil inhibiting insects.

In addition, seed treatments can also be used to repel birds, rodents, add trace elements, and legume inoculants but they will not be included in this discussion of seed treatment pesticides. Information about these other purposes can be obtained in other references.

Definition of Treated Seed

The term "see treatment" is given to the application of a pesticide chemical or any process designed to reduce, control or repel disease organisms, insects, or other pests which attack seeds or seedlings.

Crop Seeds Normally Treated

The kinds of agricultural seeds that are normally treated with one or more pesticides are: cereals-- barley, corn, millet oats, rye, sorghum, wheat; fiber crops-- cotton and flax; legumes-- soybeans, peanuts; and forage legumes (under some conditions). Many vegetable seeds are also treated.

PESTS COMMONLY ASSOCIATED WITH SEED

Disease Organisms

1. Seed decay before germination-- caused by several seed-borne fungi such as Alternaria, Fusarium, Penicillium, Rhizopus, and other species. Microscopic spores of these fungi are carried on the seed, germinate when temperature and moisture conditions are right, and grow on the germinating seed-- often causing the seed to die.
2. Damping-off and seedling blights (pre- or post-emergence)-- caused by several seed-borne and soil inhabiting fungi such as Fusarium, Helminthosporium, Phytophthora, Pythium, Rhizoctonia, and other species. They cause rots of the stem tissues near ground level and "water soaking" of seedling

tissues.

3. Root and crown rots (usually post-emergence)--caused by several seed-borne and soil-borne fungi, such as those listed immediately above. Watch for browning and sloughing of rootlets and roots and brown discoloration of crown tissues.
4. Loose and covered smuts of small grains--Ustilago species. Heads are replaced by dark-brown to black spore masses. (Fig. 13)

Insects in Stored Grains

Several insect species will attack stored grain. They can cause serious damage to seed grain if they have the opportunity to invade.

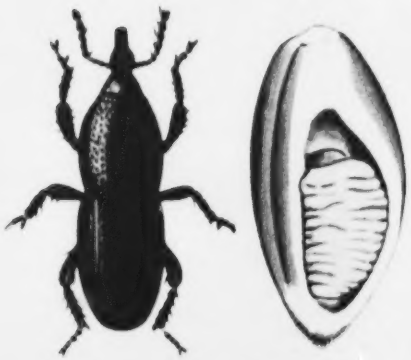
1. Beetles that bore into kernels include:
   a. Rice weevil (Fig. 6)
   b. Granary weevil (Fig. 1)
   c. Lesser grain borer (Fig. 5)
   d. Cadelle beetle (Fig. 8)
   e. Saw-toothed grain beetle (Fig. 2)
   f. Flat grain beetle (Fig. 9)
   g. Confused Flour beetle
2. Moths that attack kernels include:
   a. Angoumois grain (Fig. 10)
   b. Indian-meal moth (Fig. 7)

Insects in the Soil

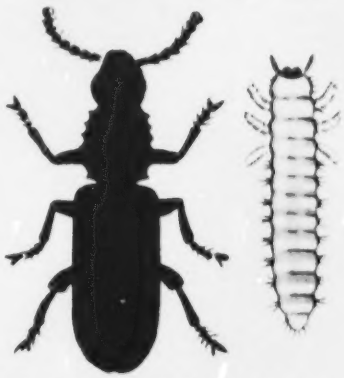
Soil inhabiting insects live in most cultivated soils. Certain species attack seed or young seedlings. They can cause serious damage to stems under some circumstances. Seed corn beetles, seed corn maggots and wireworms are known to cause damage to planted corn and other grains.

PRINCIPAL STORED GRAIN INSECTS

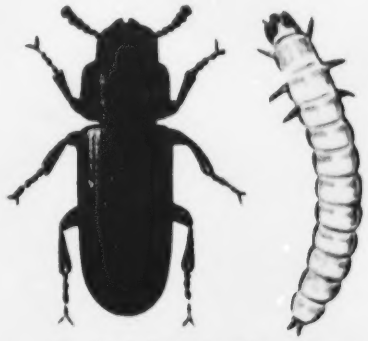
For safe and effective use of insecticides, always identify the problem correctly.



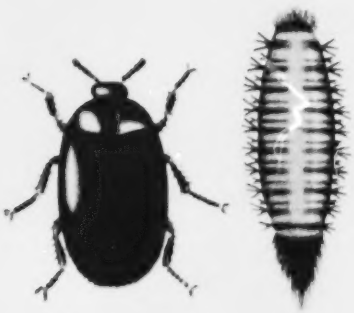
1. Granary weevil



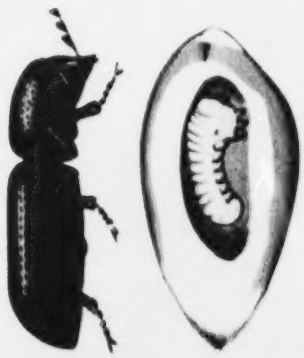
2. Saw-toothed grain beetle



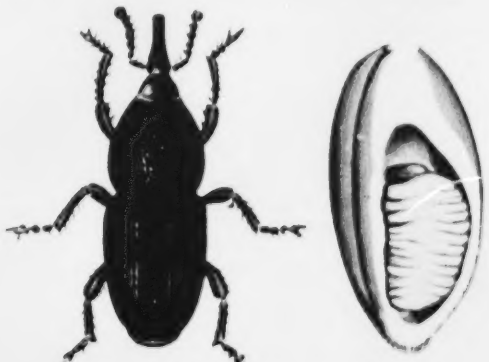
3. Red flour beetle



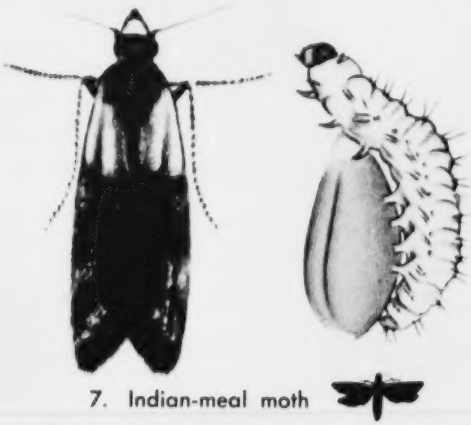
4. Larger cabinet beetle



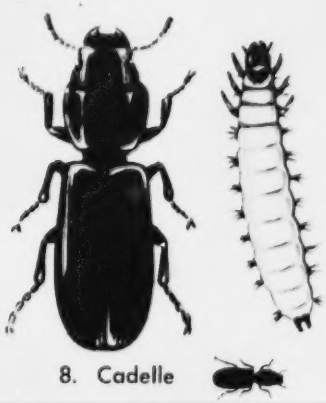
5. Lesser grain borer



6. Rice weevil

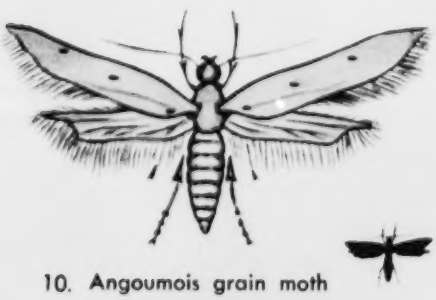


7. Indian-meal moth



8. Cadelle

9. Flat grain beetle



10. Angoumois grain moth

Some of these stored grain insects are also KITCHEN PESTS.

The saw-toothed grain beetle, red flour beetle, larger cabinet beetle, and Indian-meal moth develop in flour, cake mixes, corn meal, breakfast foods and similar products. The Angoumois grain moth infests popcorn.

Prepared by Extension Entomologists of the North Central States in cooperation with the Federal Extension Service, U. S. Department of Agriculture

Principal Stored Grain Insects of Missouri

This is the first in a series of picture sheets prepared by Extension entomologists of the North Central states in cooperation with the Federal Extension Service, U. S. Department of Agriculture.

The principal species of stored grain insects found in Missouri are pictured showing both the adult and larval forms. The small, black drawings indicate the actual size of the insects.

DESCRIPTION

1. **Granary weevils** cannot fly. Eggs are placed inside whole kernels. Damage is caused by the larvae feeding in whole grain and the adults feeding in and on whole or broken grain.
2. **Saw-toothed grain beetles** seldom fly but both the larvae and adults feed on cracked or broken grain, flour, meal, breakfast food, stock feed, candy, and dried fruit. The thorax, the body region behind the head, has saw-toothed points on both sides.
3. Larvae and adults of the **red flour beetle** and a closely related species, the **confused flour beetle,** feed on flour, grain dust, and broken grains.
4. **Larger cabinet beetles** and several closely related species are general feeders on grain and grain products. They will also feed on material of animal origin, such as hides.
5. The eggs of the **lesser grain borer** are placed on kernels and the larvae bore into the kernels. The adults can fly and also feed on grain.
6. **Rice weevil** adults can fly. Eggs are laid inside the kernel. The larvae feed in whole grain while the adults will feed both in and on grain.
7. **Indian-meal moth** larvae spin webs on the surface of grain and feed on kernels enclosed within the webbing. The larvae will also spin webs on sacked grain in storage areas.
8. **Cadelle** larvae and adults feed on whole grain. The larvae bore holes in the wood within bins where they hibernate. This is one of the largest stored grain insects.
9. **Flat grain beetles** are one of the smallest common stored grain insects. It is usually found associated with out-of-condition or insect damaged grain.
10. **Angoumois grain moth** eggs are laid on the outside of the grain. The larvae bore into the grain and feed within the kernel. Adults may fly from granaries and infest corn in the field.

CONTROLLING STORED GRAIN INSECTS

For control recommendations in farm bins see UMC Guide 7100, "Insects in Farm Stored Grain—Their Prevention and Control." For control in kitchens see UMC Guides 7374, "Angoumois Grain Moth and Indian Meal Moth;" and 7376, "Saw-toothed Grain Beetle, Confused Flour Beetle, and Red Flour Beetle." These are available at your county University Extension Center.

Issued in furtherance of cooperative extension work, acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. C. B. Ratchford, Vice-President for Extension, Cooperative Extension Service, University of Missouri, Columbia, Mo. 65201.

SEED TREATMENT PESTICIDES

Fungicides

Seed treatment pesticides designed to kill the spores of common molds and other fungi are known as "fungicides".

Formerly there were two basic sub-catagories of seed treatment fungicides: organic mercurials and non-mercurial fungicides. Since the E.P.A. cancelled most of the organic mercurial fungicides, ethyl and methyl mercury materials are no longer allowed. However, several non-mercurials are available for use on agricultural seeds. Certain systemic fungicides are also available for control of internally seed-borne diseases such as loose smut.

Fungicide seed treatments may be divided into three categories depending on the nature and purpose of the treatment. These categories are: (1) seed disinfection, (2) seed disinfestation, (3) seed protection.

1. Seed disinfection-- disinfection is the elimination of disease-causing organisms (pathogens) which have penetrated and become established in living cells of the seed.
2. Seed disinfestation-- disinfestation is the control of fungus spores and other forms of pathogenic organisms found on the surface of the seed.
3. Seed protection-- seed protection involves chemical treatment to protect the seed and young seedlings from pathogenic organisms in the soil. (Fig. 11)

Note: A given fungicide may serve in one or more of these categories.

The type of chemical formulation used for seed treatment dictates the method of application to be used. Seed treatment materials are usually applied to seeds in one of three forms: (1) dusts, (2) slurries (a mixture of wettable powder in water), and (3) liquids.

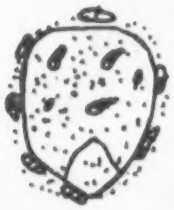
Based on composition, seed treatment fungicides may be organic or inorganic, metallic or non-metallic, and, until recently, mercurial or non-mercurial. Before the cancellation of the volatile mercurials (ethyl and methyl mercurials), fungicides were also classified as volatile and nonvolatile. With their elimination, most fungicides now approved for use on seeds are non-volatile. When using this type of material, complete coverage of the seed is necessary to obtain effective control. Commonly used non-mercurials are: captan, thiram, maneb, mancozeb, terraclor, etc.

Certain systemic fungicides, a fairly new class of pesticides are now used as seed treatment materials. Their key advantage is the ability to move inside the seed or plant and control a pest. When used according to label recommendations, systemic chemicals are translocated through the host seed or plant. They control or retard the growth of certain fungi and insects (often quite specific) without adversely affecting the host's metabolic system.

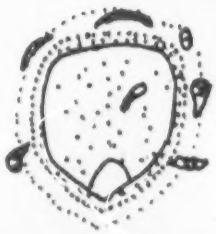
Currently, a carboxin material, Vitavax, is very effective as a systemic fungicide against loose smut of wheat (Ustilago tritici) or barley (U. nuda). It has generally replaced the rather laborious hot-water or water-soak (anaerobic) methods which were necessary to obtain control of the internal seed infection.

SEED PROTECTANT FUNGICIDES

Fig. 11



Inhibit surface borne Pathogens

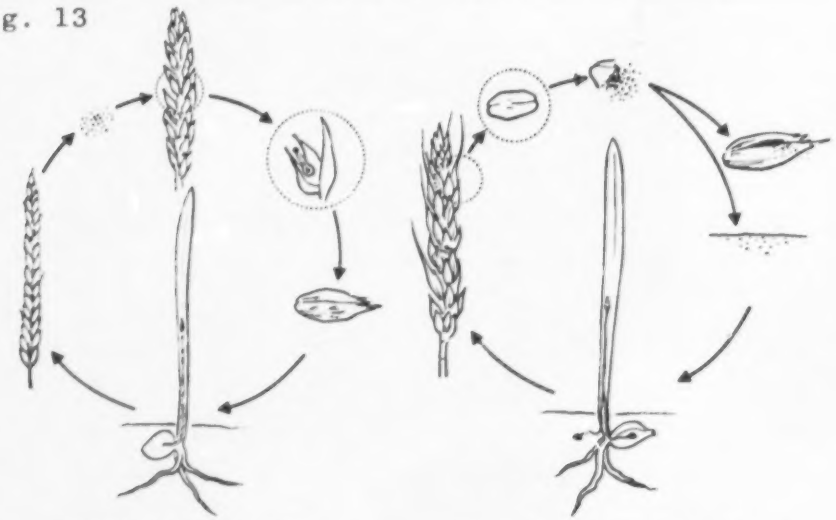


Protect against soil-borne Pathogens

Fig. 12 SYSTEMIC SEED FUNGICIDES

Inactivate internally seed borne pathogens
e. g. Wheat loose smut (U. tritici)

Fig. 13



Life cycle of loose smut of wheat
Spores reaching florets of healthy plants at blossoming time winter over in seed.

Life cycle of covered smut, or bunt, of wheat
Spores in soil and on seed infect seedlings of next year's crop.

The loose smut fungus spores infect the seed internally. A systemic fungicide is necessary for control. The covered smut fungus spores are borne on the seed surface. A protectant-eradicant fungicide will provide control.

Insecticides

Insecticides are often applied to seeds to control or reduce insect damage during storage and to reduce damage from soil insects such as wire worms and seed corn maggots. The two most widely used and recommended insecticidal seed treatments are diazinon and lindane. However, any carry over supplies of aldrin, dieldrin, and heptachlor which are labelled for these specific purposes may still be used.

Be sure that the crop seed under consideration is listed on the label of any insecticidal seed treatment that is used. And be sure that the label plainly states that the product is formulated for use as a seed treatment. Some formulations intended for other uses can injure seeds.

Fungicide-Insecticide Combinations

Whenever an insecticide is applied to seed, a fungicidal treatment should also be used as the purposes and effects are different. The advantage of combination seed-treatment formulations is that the proper proportions of chemicals have been established in only one formulation.

However, under some conditions such as extremely bad infestations of soil insects following summer fallow or grass sod, extra insecticide might be required. In this case, the already prepared combination treatments present a disadvantage.

Since some of the pesticides are selective in the control of pests, frequently two or more compounds are combined in the treater tank. Or an extra tank may be used to give the spectrum of activity needed.

The manufacturers of pesticides are now making combinations available to seed processors. But should a processor blend two or more pesticides, the compatibility of the materials must be determined, as some combinations of materials may seriously reduce seed germination. When applying two or more pesticides at different times, the sequence of application is also important. The insecticide may be needed in storage; the fungicide just prior to seeding.

Whether a single pesticide or a combination is to be applied to the seed, read the label and follow the manufacturers' directions carefully.

PESTICIDE LABELS

Before using any pesticides, carefully read and analyze the information on the label of the container. The importance of the pesticide label to you and your employees cannot be overestimated. The few short paragraphs on the label sum up the results of years of research and development.

The label contains this concise information about the product:

1. Name of product-- usually a coined name used by the manufacturer (e.g. Captan 80 Seed Protectant or Arasan 50 - Red, etc.)
2. Name of manufacturer.
3. E.P.A. registry number and U.S. patent number.
4. Ingredient statement-- label includes percentage of active ingredient and inert ingredients that make up total amount of material. For example, Arasan 50 - Red has active ingredient: Thiram (Tetramethyl thiuram disulfide) 50% and inert ingredients 50%.

5. Statement of Hazard-- if material is relatively safe, it will have the word "CAUTION"; intermediate toxicity to warm-blooded animals will bear "WARNING"; those that are highly toxic will say "POISON" and bear the skull and crossbones symbol.
6. Personal Precautions-- together with the hazard statement, some personal precautions may be added. Examples include: "Do not inhale dust", "Do not get in eyes or on skin", "Wash thoroughly after handling", and very likely "Keep out of reach of children".
7. Compatibility and Plant Safety-- a statement which indicates whether the product can be combined safely and effectively at recommended dosages with other pesticides, and the levels at which the product may be injurious to plants.
8. Directions-- how to apply and rates of application.
9. Kinds of pests controlled.
10. Crops on which product can be used.
11. Warranty statement.
12. How to dispose of container and unused product.

All manufacturers of seed-treatment chemicals must prove that the chemical registered with the Environmental Protection Agency is effective for the purpose claimed and is non-phytotoxic (does not injure plants) at dosage shown on the label. For best results follow the recommended rates of application.

Label registration does not necessarily imply effectiveness. Seed treatment chemicals, as many other items for sale today, vary in their capability to control certain pests. The labels usually specify the capability and limitations of the product. Consult with plant pathologists or Extension Service specialists for additional information about performance.

SEED TREATMENT APPLICATION

Seed treatment chemicals may be applied to seed in small lots by the farmer, or they may be applied to large seed lots by commercial seedsmen using expensive and specialized seed treating equipment.

On-the-farm applications are usually made at planting time by seed-drill and planter-box treatments, using powder formulations. When powders or dusts are used in the seed drill or planter box, be sure they carry label recommendations for such use. Wettable-powder seed chemicals should not be used as dusts.

Liquid-seed-treatment formulations can be applied on the farm by using a spiral grain-loading augar for mixing. Whatever method is used, the farmer must be sure that the dosage recommended on the label is applied to the seeds and that the chemical and seeds are mixed immediately and thoroughly for the best possible coverage.

Commercial Application

Generally, commercial seed treatment is more accurate, and coverage of the seed is more uniform because commercial applicators use special seed treating equipment. Those engaged in commercial or custom seed treating usually have good machines that will ensure proper proportioning and proper mixing of seed and chemical. Most seed-treating equipment has a proportioning device consisting of a double-chambered scale supported on an axle on the arm. One end of the axle has an arm attached to a sliding weight which can be adjusted to counter-balance a uniform volume of seed, regardless of the seed's weight per bushel. To the other end of the axle is attached a pair of inter-

changeable dippers that will deliver a measured amount of chemical. The chemical is applied each time the lever is tripped by a set quantity of grain that overbalances the sliding weight. This simple arrangement prevents any chemical from being applied to the seed until there is enough weight in the chamber to cause the scale to trip. The moment the scale is tripped, the chemical is distributed uniformly over the seed by tumbling in a large, slowly revolving drum, or uniform distribution is attained by the seed falling through a curtain of chemical mist.

SEED TREATING EQUIPMENT

Commercial seed treaters are designed to supply accurately measured quantities of pesticides to a given amount of seed. Basically, three types of commercial seed treaters are on the market: (1) Dust Treaters, (2) Slurry Treaters, and (3) Direct Treaters-- applied as liquid or liquid mist.

Dust Treaters

The dust or dry type seed treater (Fig. 14) is designed especially for gentle handling of seeds combined with an efficient and effective method of applying dry formulations with uniform distribution on the seeds. It is especially adapted to treating legume seeds such as peanuts and soybeans, vegetable seeds, grass seeds, sugar beet seeds, and other free flowing seeds.

General Operation:

A double-weight pan system provides rapid and consistent seed flow. The seed gates in the hopper are adjusted simultaneously to increase or to decrease the flow of seed to the machine.

The dry chemical powders are fed into the seed stream by a vibrating feeder and covers the entire band of

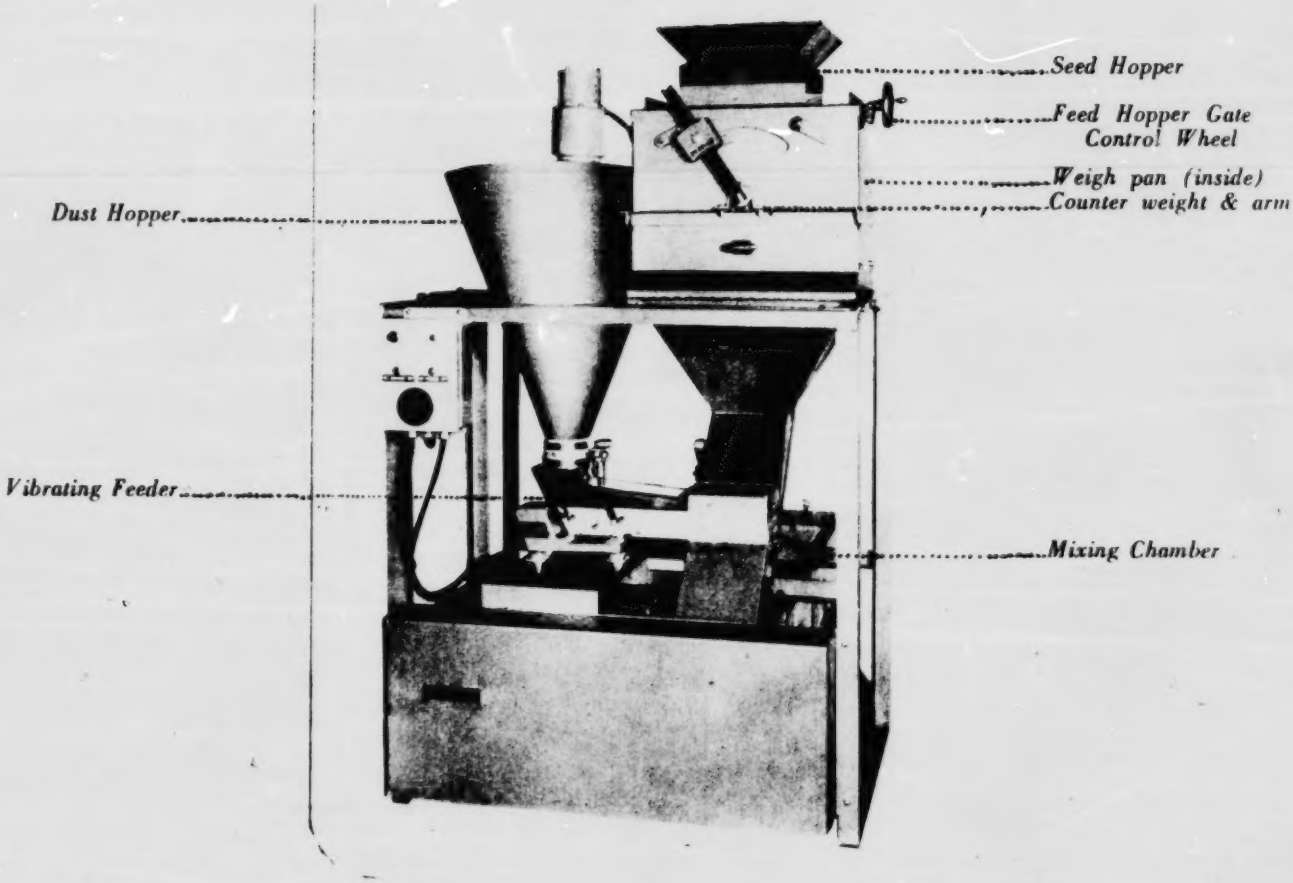


Fig.14 Dust Treater

Dust Treater

(Using Gustafson XL Dry Powder Seed Treater as an example):

seed to assure complete coverage. The chemical is applied before the seed gets to the mixing chamber so that coverage is started immediately.

To obtain this coordinated flow of seed and of chemical to the seed, the unit is fitted with electric micro-switches at the weigh-pan-dump shaft. Each time the pan load of seed is dispensed, the proper amount of chemical is fed into the seed stream.

To retain consistency of the dry chemical, the unit also has its own motor-driven, direct-fluffing motivator. It conneets with the electric micro-switch at the pan-dump shaft.

A variable speed drive keeps the seed at a constant level in the mixing chamber and assures gentle handling. A wide range of chemical applications can be obtained through a vibrating feeder while retaining fine coverage with all types of seed.

Calibration:

To apply the correct amount of powder to the seed flow, first run a given number of pounds of seed (such as 100 lbs) through the feeder. Use the measuring cup provided with the feeder to catch the powder as it comes off the vibrator. After the given amount of seed has run through, weigh the powder to determine how much is being applied to that amount of seed. Then adjust the vibrator accordingly. Run additional tests until the proper setting of the vibrator is determined.

Consult the manufacturer's manual for specific operating instructions, adjustments, and calibration.

Slurry Seed Treater

The slurry treatment principle involves suspension of wettable powder treatment material in water. The treatment material applied as a slurry is accurately metered through a simple mechanism composed of a slurry cup and seed dump pan. The cup introduces a given amount of slurry with each dump of seed into a mixing chamber where they are blended.

Operating a slurry treater (Fig. 15) is relatively simple, but operation procedures must be thoroughly understood.

The metering principle is the same in direct, ready-mix or fully automatic treaters (i.e., the introduction of a fixed amount of slurry to a given weight of seed).

To reach a given dump weight, slurry treaters are equipped with a seed gate that controls seed flow to the dump pan. With the proper seed gate seeting, the operator can maintain a constant dump weight for a given seed.

The amount of treatment material applied is adjusted by the slurry concentration and the size of the slurry cup or bucket. The dump pan fills to a point where it over balances the counter weight and dumps into the mixing chamber. This brings the alternate weighing pan in position to receive the inflow of seed and triggers a mechanism that adds a cup of slurry to the mixing chamber. That way, one cup of slurry is added with each dump of seed.

The mixing chamber is fitted with an auger type agitator that mixes and moves seed to the bagging end

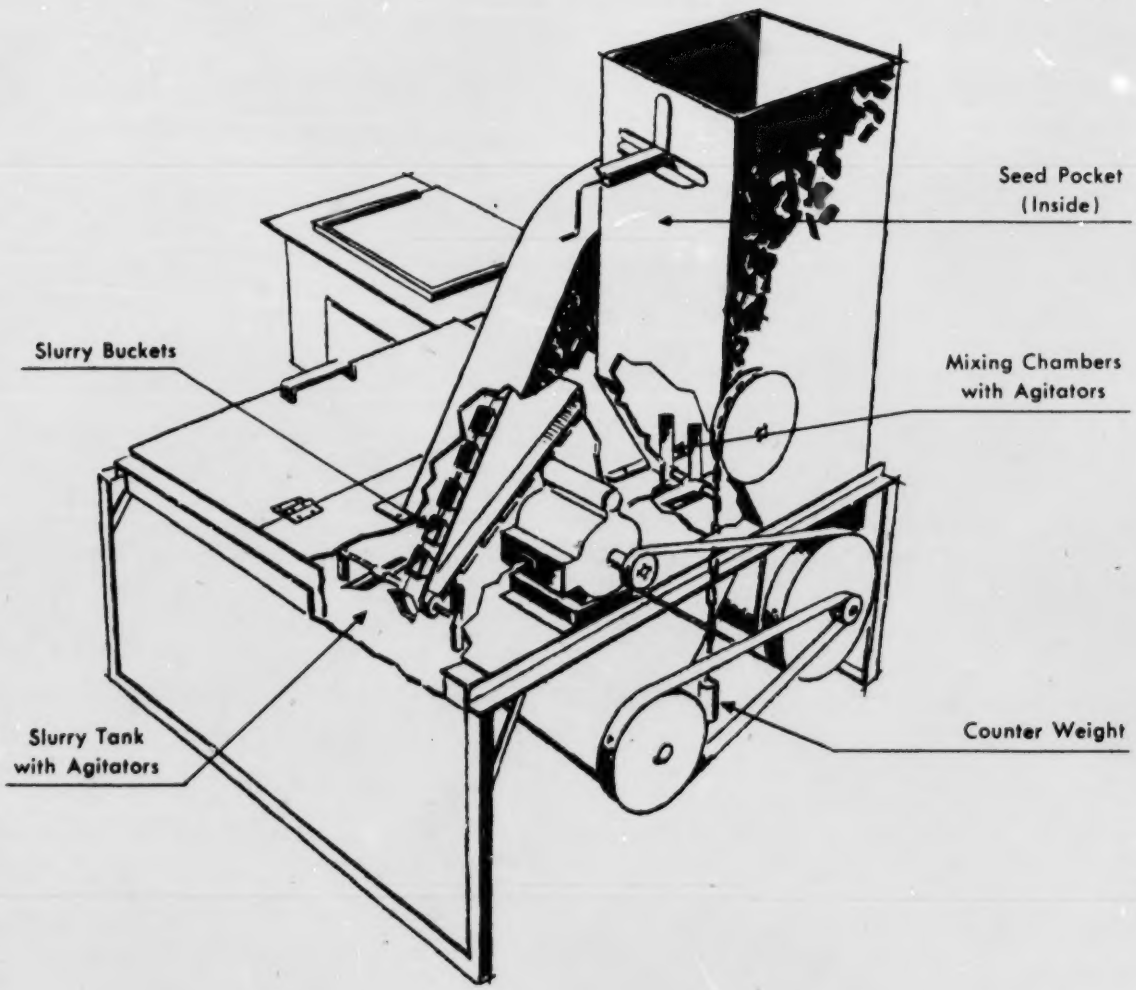


Fig. 15 Slurry Seed Treater

of the chamber. The speed of the auger is important because at slow speeds more uniform distribution is obtained.

Slurry tanks have 15 to 35-gallon capacities depending upon the size of the treater. They are equipped with agitators that mix the slurry in the tank and keep it suspended during operation. It is important that the powder be thoroughly suspended in water before treating. If the treater has been idle for any period of time, sediment in the bottom of the slurry cups must be cleaned out.

The proper size slurry cup must be used. Most machines now have cups with ports and rubber plugs for 15 cc, 23 cc, and 46 cc quantities. Some users prefer to mix the slurry in an auxiliary tank and then transfer to the slurry chamber as needed.

Direct Treaters-- Liquid

Direct treaters are the most recent development and include the Panogen and Mist-O-Matic treaters. These two were initially designed to apply undiluted liquid treatment. Instead of applying 23 cc of material per 10 pounds of wheat, as in slurry treaters, they apply 14 to 21 cc (1/2 to 3/4 ounces) per bushel of wheat. This small quantity of material is suitable only with liquid materials which are somewhat volatile and do not require complete, uniform coverage for effective action.

Since the EPA cancelled the volatile mercury seed treatment chemicals (Panogen or Ceresan L), Panogen-type machines must be modified to handle the liquid seed treatment chemicals currently used.

Later modifications for treaters include dual tanks that permit simultaneous addition of a fungicide and an insecticide. Another type includes adaptations for the application of slurries. The metering device in both these treaters is similar to that of the slurry treater, since metering is attained through synchronization of a treatment cup and seed dump. Otherwise, they differ decidedly from the slurry treater and from each other. Both of these direct treaters have an adjustable dump pan counter weight to adjust the weight of the seed dump. This is not practical with slurry treaters.

Mist-O-Matic Seed Treaters.

The "mist-o-matic" treater (Fig. 16) applies treatment as a mist directly to the seed. The metering operation of the treatment cups and seed dump is similar to that of the "Panogen" treater (described later). Cup sizes are designated by the number of cc's they actually deliver, e.g., 2 1/2, 5, 10, 15, 20, and 40. The treater has a large treatment tank, a pump and a return that maintains the level in the small reservoir used to fill the treatment cups.

After metering, the treatment material flows to a rapidly revolving fluted disc mounted under a seed spreading cone. The disc breaks drops of the treatment into a fine mist and sprays it outward to coat seed falling over the cone through the treating chamber. Just below the seed dump are two adjustable retarders designed to give a continuous flow of seed over the cone between seed dumps. This is important since there is a continuous misting of material from the from the revolving disc. The desired treating rate is obtained through selection of treatment cup size and proper adjustment of the seed dump weight.

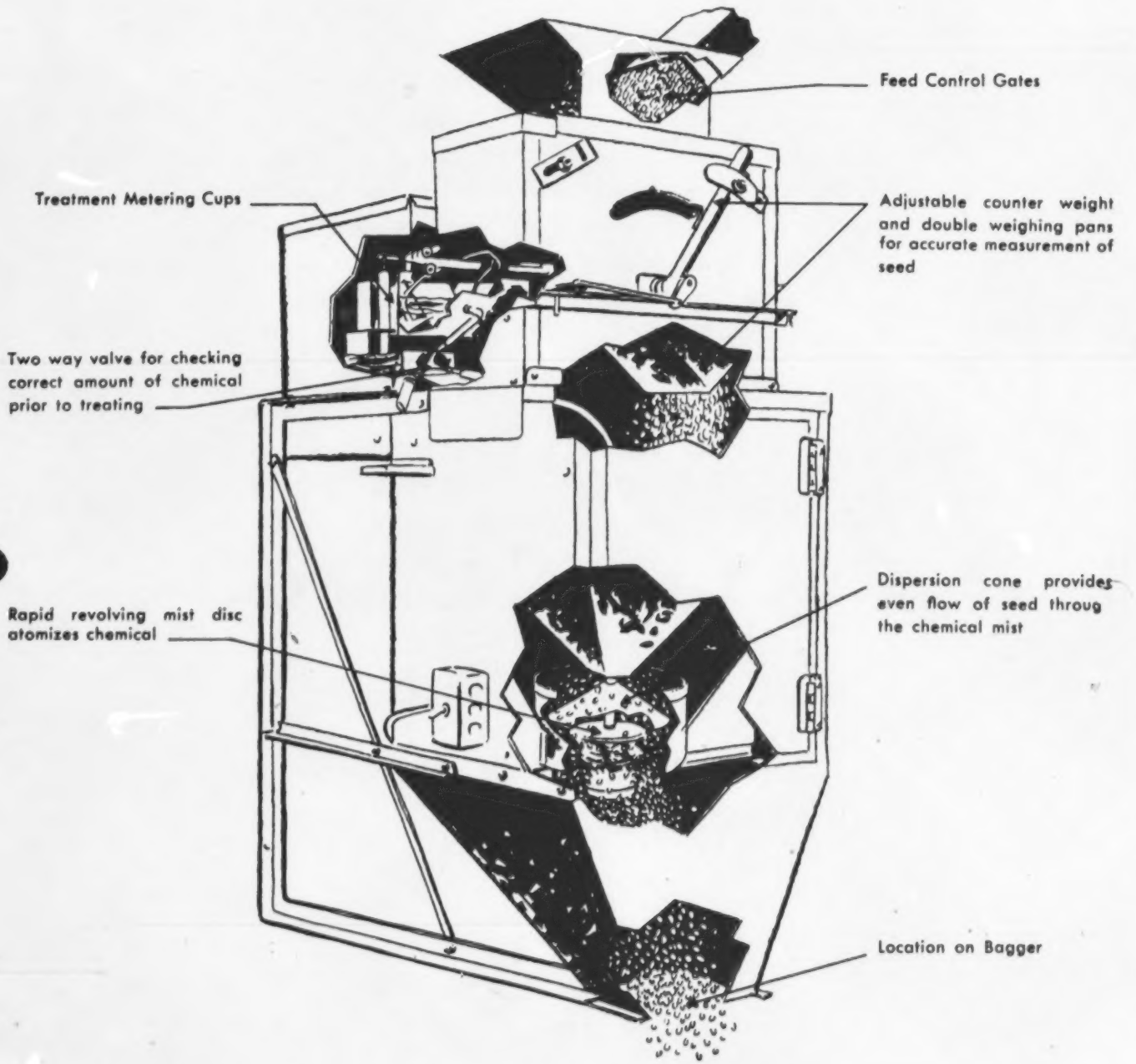

Feed Control Gates
Treatment Metering Cups
Adjustable counter weight and double weighing pans for accurate measurement of seed
Two way valve for checking correct amount of chemical prior to treating
Dispersion cone provides even flow of seed throug the chemical mist
Rapid revolving mist disc atomizes chemical
Location on Bagger

Fig.16 Mist-O-Matic Seed Treater

Panogen Seed Treater.

Operating the Panogen treater (Fig. 17) is relatively simple. A small treatment cup, operating from a rocker arm directly off the seed dump pan and out of a small reservoir meters one cup of treatment with each dump of the seed pan. Liquid fungicide flows through a tube to the head of the revolving drum that is the seed-mixing chamber. It flows in with seed from the dumping pan and is distributed over the seed from the dumping pan and is distributed over the seed by the rubbing action of the seed passing through the revolving drum.

The desired treating rate is achieved by using the right sized treatment cup and by adjusting the seed dump weight. Treatment cup sizes are designated by the treating rate in ounces and not by actual size. For example, the 3/4-counce cup applies 3/4 ounce (22.5 cc) of treatment per bushel with six dumps per bushel. The actual size of the cup is 3.75 cc.

CALIBRATING A SLURRY OR LIQUID SEED TREATER

1. Determine how much liquid your treater's metering cup or bucket will dump into the seed each time the ~~weight~~ted seed pan trips. Record for future use.
2. Run seed slowly into the treater until the weighted seed pan dumps seed into the treater. Shut off the feed to the treater immediately. Weigh the amount of seed dumped into the treater. Record the setting of the weight on the weight balance arm and the weight of the grain dumped for future use.
3. Determine the number of dumps per bushel by dividing the weight per dump into the bushel weight of your

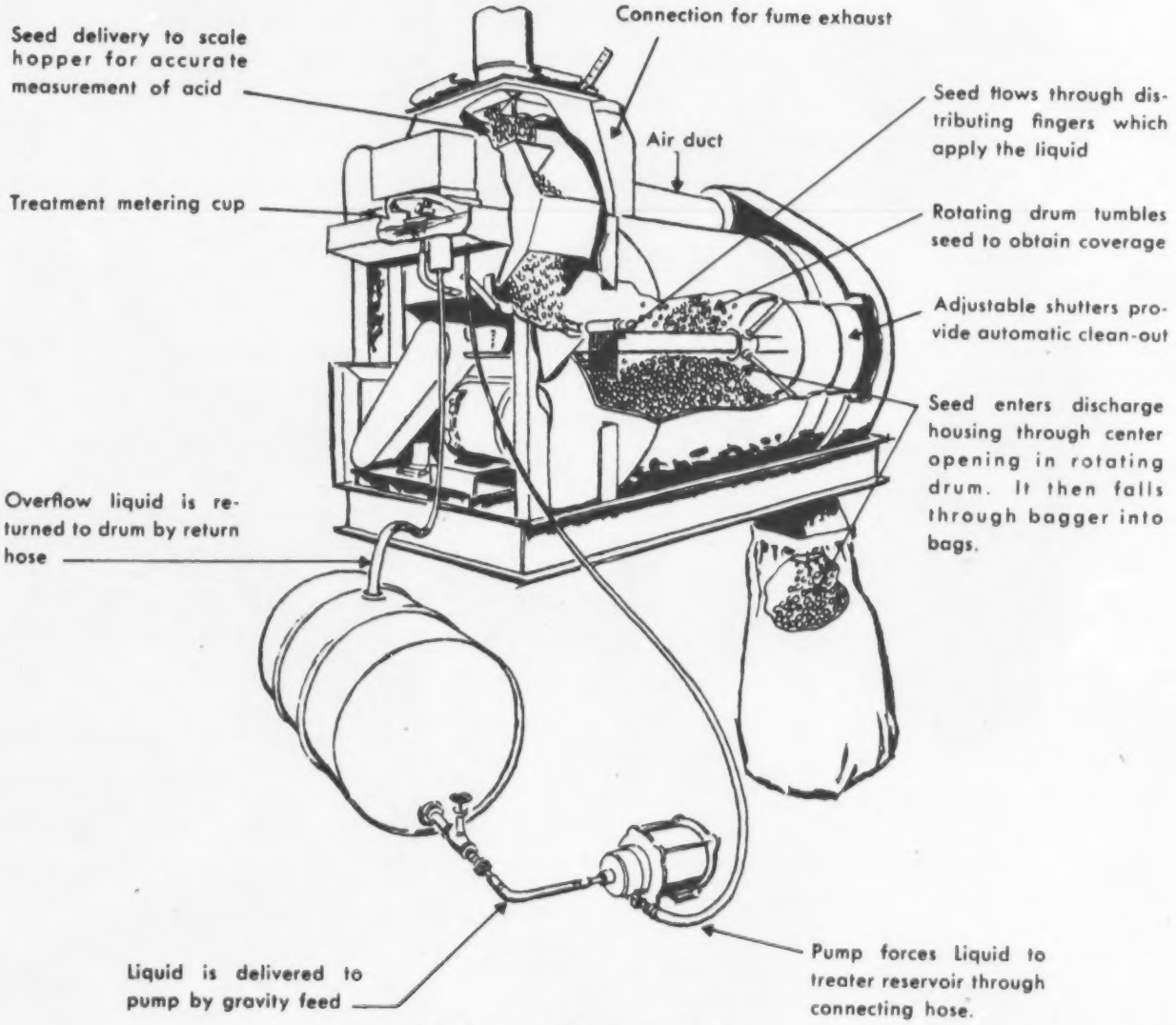

Seed delivery to scale hopper for accurate measurement of acid
Connection for fume exhaust
Air duct
Seed flows through distributing fingers which apply the liquid
Treatment metering cup
Rotating drum tumbles seed to obtain coverage
Adjustable shutters provide automatic clean-out
Seed enters discharge housing through center opening in rotating drum. It then falls through bagger into bags.
Overflow liquid is returned to drum by return hose
Liquid is delivered to pump by gravity feed
Pump forces Liquid to treater reservoir through connecting hose.

Fig. 17 Panogen Seed Treater

seed. For example, a treater dumps 6 pounds of wheat each time the seed pan trips. Dividing 60 pounds per bushel by 6 gives 10 dumps per bushel.

4. Determine how much of the liquid or slurry you are applying per bushel of seed. To do this, multiply (1 above) the amount of chemical your metering cup dumps into the seed by (3 above) the number of dumps per bushel. Since most metering cup capacities are measured in cc while the chemical recommendations are in ounces per bushel, divide the result by 29.57 to give the liquid ounces per bushel applied.

$$\frac{\text{Metering cup capacity in cc}}{29.57} \times \text{Number of dumps per bu.}$$

equals ounces of liquid applied per bushel.

For example:

$$\frac{46 \text{ cc} \times 10 \text{ dumps}}{29.57} = \frac{460}{29.57} = 15.6 \text{ oz. liquid per bu.}$$

5. To determine the correct amount of powdered chemical to add to one gallon of water for a slurry mixture, divide 128 by the number of ounces of liquid applied per bushel and multiply the result by the ounces of the chemical you want to apply to one bushel.

$$\frac{\text{128 ounces per gallon}}{\text{Oz. liquid applied/bu}} \times \text{oz. powdered chemical/bu.}$$

equals ounces of slurry to add to one gallon of water.

For example:

$$\frac{128}{15.6} \times 1.5 = 12.3 \text{ ounces powdered chemical to add to one gallon of water.}$$

Note: For additional information see the Calibration instruction manual furnished with each machine by the manufacturer

REQUIREMENTS FOR LABELING OF TREATED SEED (FEDERAL AND STATE)

Information required to be shown on the label:

1. A word or statement in type no smaller than 8 points (roughly 1/8 inch) indicating that the seed has been treated.
2. The commonly accepted name-- whether coined, chemical, or abbreviated chemical (generic) name of the applied substance and the rate of application.
3. A caution statement if the substance used in the treatment stays on the seed in amounts harmful to humans or other vertebrate animals.
4. Seed treated with any highly toxic substance, shall be labeled to show a statement such as "poison treated" in red. In addition, the label shall show a representation of a skull and crossbones.

POISON TREATED

CAUTION

DO NOT USE THIS SEED FOR FOOD OR FEED OR OIL PURPOSES

XXX DO NOT DUMP UNUSED SEED OR CONTAINER, TO DISPOSE BURY 18 INCHES DEEP XXX

LIST NAME OF MATERIAL AND RATE

Fig. 18 Sample Label for highly toxic pesticides.

5. Seed treated with less toxic substances, if the amount remaining with the seed is harmful to humans or other vertebrate animals shall be labeled to show a caution statement in type no smaller than 8 points, such as: "Do Not Use for Food, Feed, or Oil".

Fig. 18 and 19 are minimum labeling requirements and the label may contain additional information, such as: (a) Purpose of Treatment, (b) Antidotes, (c) Safety Precautions, and (d) Procedures to follow in case of an accident.

TREATED

List

Name of

Material

and rate

WARNING
DO NOT USE FOR FOOD, FEED OR OIL PURPOSES.

Fig.19 Sample Label for Less Toxic Substances

COLORING OF TREATED SEED

All interstate shipments of food seeds-- such as wheat, corn, oats, rye, barley and sorghum-- bearing a poisonous treatment in excess of a recognized tolerance must be denatured by a suitable color to prevent their use as food, feed or oil. Seed must also be colored if it bears a poisonous treatment for which no tolerance or exemption from tolerance is recognized.

Many of the pesticides now come from the factory with the dye or color added as a convenience to the operators. However, some seed processors prefer to mix the dye with the pesticide at the plant so that the desired color may be obtained. Most treated seeds are now colored. The dye causes no apparent injury to seed germination or danger to personnel processing or using the seed.

PESTICIDE CARRIERS, BINDERS AND STICKERS

These materials are listed on the label as inert ingredients. There is no requirement that the name of these materials be given. They are selected by the processor and are usually neutral in pH, non-toxic to humans and cause no apparent damage to the germination of the seed.

SAFETY PRECAUTIONS

Precautions for handling, sorting, mixing and storage of treated seed:

1. Read the label and follow instructions carefully as over treatment may injure the seed and under treatment will not control the pest.

2. When handling toxic substances, the operating personnel must be provided with protective clothing such as:
   a. coveralls
   b. cap
   c. protective glasses
   d. rubber apron
   e. rubber boots
   f. rubber gloves
   g. respirator designed for use with the material.

   Personnel should not inhale the dust or vapor nor permit the material to contact the skin or eyes. Operators should wash thoroughly with soap and water before eating and smoking. Bathe immediately after work and change all clothing. Wash clothing thoroughly with soap and hot water before re-use. In case of contact, immediately remove contaminated clothing and wash skin thoroughly with soap and water.
3. A safety shower should be installed in the immediate vicinity of the treater.
4. An exhaust system should be installed to remove vapors and dust from the operating area. The exhaust air should discharge into a cyclone or bag-type dust collector. The treater should also be vented and tied into the exhaust system.
5. Seed treaters should be isolated and not operated in the vicinity of other personnel or farm commodities that are to be used for food, feed or oil.
6. Special multiwall (3 or 4-ply) or tightly woven bags are recommended for seed that has been treated with toxic substances. Seed should be thoroughly dry before going into the bag. Excessive moisture can cause the seed to deteriorate rapidly.

7. Store treated seed in a dry cool place away from food or feed products.
8. Seed treaters should be thoroughly cleaned after use as some of the pesticides are corrosive and others settle out and cause the equipment to clog. Do not run contaminated water into a stream or public sewer, but discharge it into a shallow ground pit.

Safety Precautions:

Safety precautions in the use of treated seed and the disposal of unused treated seed and empty pesticide and treated seed containers.

1. The user of treated seed should read and follow the label carefully.
2. Planter hoppers should be filled out-doors.
3. Do not breathe dust or fumes from treated seed or get it in the eyes or on skin. Wash thoroughly with soap and warm water after handling treated seed.
4. Use treated seed as seed only, and never introduce them into the food and feed channels. To do so, may cause serious injury to poultry, livestock, and humans, and constitutes a serious label violation.
5. Do not re-use pesticide containers. Destroy them by mutilation and bury them at least 18 inches deep in an isolated area away from water supplies. Follow manufacturer's recommendation for decontamination and container disposal for large containers such as 55-gallon drums.
6. Empty treated seed containers and low germinating seed should be destroyed by burying at least 18 inches deep in an isolated area away from the water supplies. Note: Treated seeds exposed on soil surface will be hazardous to birds and wildlife.

For additional instructions in the use of seed treatment chemicals and listings of materials that have labels for use on specific seeds, consult your University Extension Service Office.

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Issued in furtherance of cooperative extension work, acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. Carl N. Scheneman, Vice President for Extension, Cooperative Extension Service, University of Missouri, Columbia, Mo. 65201. The University of Missouri is an equal employment and educational opportunity institution.